POWER SUPPLIES UNLIMITED

TFC

NJE CORPORATION KENILWORTH, NEW JERSEY

A SUBSIDIARY OF CONDEC CORPORATION

INSTRUCTION

MANUAL

REGULATED POWER SUPPLY
TRANSISTOR - DRIVEN FREQUENCY CHANGER
60 to 400 CPS

MODEL
TFC

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801776

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WARNING

THIS EQUIPMENT EMPLOYS VOLTAGES WHICH ARE DANGEROUS AND CAN BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION MUST BE EXERCISED WHEN WORKING WITH THIS EQUIPMENT.

INTRODUCTION

DEVIATIONS:

This manual covers the Standard NJE Power Supplies as indicated in Section I herein. Where deviations to the specifications are built into equipment at the customer's request, the nature of the deviation as it affects this manual is indicated in a Specification Sheet which precedes Section I. If special Schematic Diagrams, Parts Placement Drawings and/or Spare Parts List(s) are required for the deviation, they will be found in Section V of the manual, in place of, or along with the Standard material.

CORRESPONDENCE:

All correspondence must reference the complete description of the unit as shown on the identification label located at the rear of the power supply.

In requesting Spare Parts or information relative to parts, the Reference Designation, the rating, the description, and the NJE Part Number must be specified for each part in question.

DESIGN IMPROVEMENTS:

NJE Corporation reserves the right to make design improvements on any instrument without prior notice.

REPRODUCTION:

No written material, drawings, text figures, or any part of this Instruction Manual may be reproduced without express written consent of NJE Corporation.

801595
Rev. A.: 6/19/67

REPAIR SERVICE

NJE Corporation provides complete repair facilities at the main plant and at local service centers as listed in the rear of the manual. These repair facilities are adequately staffed with factory trained technicians to assure our customers of the most knowledgeable and expedient servicing of our equipment. All equipment forwarded to these facilities must be adequately packaged to prevent damage in transit.

OUT OF WARRANTY SERVICE:

Forward defective equipment to factory or local service center prepaid. A full description of difficulties encountered or the repair required should accompany this shipment. An estimate of the cost of repair will be submitted to you. The necessary servicing will be performed only upon receipt of your written service orders. Your equipment will be returned to you via collect shipment unless otherwise specified on your service order.

IN WARRANTY SERVICE:

If, during the warranty period the power supply indicates an inherent defect, immediately communicate with your nearest NJE Field Representative in your area. If, after examination, he concurs that the unit is defective under the warranty conditions, he will provide written authorization for the return of the unit to the factory or the local field service center, whichever is nearer. NJE Corporation will not assume any transportation charges on incoming equipment without the concurring written approval from its field representative.

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SECTION 1

SPECIFICATION AND DESCRIPTION

1.1 General Description: NJE Model E/TFC-is a low-cost frequency changer, using completely solid state components, silicon power rectifiers, silicon zener diode reference and germanium control and power transistors. 90% of the wiring is accomplished with printed circuitry.

1.2 Electrical Specifications:

Input:

Model	Volts (50/60 CPS) (Single Phase)	Frequency	Line Current	Power factor
E/TFC 115-100	105-125 207-253	50-65 cps	3.5A	0.8
E/TFC 26-100	105-125 207-253	50-65 cps	3.5A	0.8
E/TFC 115-200	105-125 207-253	50-65 cps	7 A	0.8
E/TFC 26-200	105-125 207-253	50-65 cps	7 A	0.8

The input is arranged for either 115 or 230 volt. The units are factory arranged for 115 volts. For 230 vac input see schematic.

Output: Continously adjustable by front panels potentiometer as indicated below.

Model	Volts Range	Volt Amperes Range (Zero to unity) (P.F. Lagging)	Frequency Range
E/TFC 115-100	105-130	0-100	380-420 cps
E/TFC 26-100	24-30	0-100	380-420 cps
E/TFC 115-200	105-130	0-200	380-420 cps
E/TFC 26-200	24-30	0-200	380-420 cps

OUTPUT CHARACTERISTIC

Model No.	Maximum Distortion	Maximum Amplitude Modulation	Static Frequency Regulator	Static Load Regulator	Static Line Regulator
E/TFC 115-200	5%	3%	± 1/2%	± 1%	± 1/2%
E/TFC 26-100	5%	3%	± 1/2%	± 4%	± 1/2%
E/TFC 115-200	5%	3%	± 1/2%	± 1%	± 1/2%
E/TFC 26-200	5%	3%	± 1/2%	±4%	± 1/2%

For greater accuracy on the 200 VA models, tuning fork options are available. 100 VA models may have tuning fork located externally.

1.2.1 Input line Transient: For a line step of ±10%, the output voltage excursion will not exceed 2%.

1.2.2 Recovery: 30 milliseconds maximum for a load step change from full load to full load.

10 milliseconds maximum for a load step change from full load to no load.

1.2.3 Output Overshoot: Maximum overshoot 15V peak, on 26V unit maximum overshoot will not exceed 5V peak.

1.2.4 Polarity: The output can be floated up to 500 volts peak above or below ground. Either, line may be grounded to chassis.

1.2.5 Protection: The current is electronically limited during momentary overload or short circuit. If the overload persists the load is disconnected from the supply by a fuse. The power transistors are protected against over-temperature by an automatic resetting thermal switch.

1.2.6 Remote Programming Features: Remote Frequency Programming terminals are available at the rear of the chassis.

Remote Voltage Pragramming terminals are available at the rear of the chassis.

1.2.7 Multiphase Operation: External Synchronization Terminals are provided for operating units as a 2 or 3 phase generator in conjunction with the adapter Model TPAR 3-30 or TPAB 3-30. The frequency changer can also be synchronized at this point by a precise laboratory generator. Consult factory for details.

1.2.8 Meters: Output voltmeter and ammeter accurate to 2% of full-scale rating are furnished installed on the front panel. Meters not suppled on ETFC models:

1.2.9 Duty: Rated for continous duty at ambient temperatures of from 0° to 40° C with 60-cycle input. With 50 cycle input, the supply is rated for continuous duty at ambient temperatures of 0° to 35° C. For operation outside of this temperature range, contact the factory.

1.2.10 Voltage Stability: After a 1/2 hour warmup with constant load and constant temperature the output voltage will not drift more than 0.1% for an 8 hour period.

1.2.11 Frequency stability: After a 1/2 hour warmup with constant load and constant temperature the output frequency will not drift more than 0.2% for an 8 hour period.

1.2.12 Voltage temperature Coefficient: After a 1/2 hour warmup with constant load the average temperature coefficient will not exceed 0.1%/°C.

1.2.13 Frequency temperature coefficient: After a 1/2 warmup with constant load the average temperature coefficient will not exceed .05%/°C.

1.2.14 Output VA: Can be increased linearly to 140% of maximum VA rating at zero lagging power factors.

1.2.15 Termination: Input, output, remote programming and synchronization terminals are available on barrier type terminal strip at rear of chassis. 400 cycle output is also available on the front panel.

1.3 Mechanical Specifications:

1.3.1 Dimensions and Weight:

Model	H(in)	W(in)	D(in)	Net Weight	Shipping Weight
E/TFC 115-100	4/11/16	8 1/4	15 3/8	22 lbs.	30 lbs.
E/TFC 26-100	4/11/16	8 1/4	15 3/8	22 lbs.	30 lbs.
E/TFC 115-200	5 1/4	19	16 5/8	41 lbs.	60 lbs.
E/TFC 26-200	5 1/4	19	16 5/8	41 lbs.	60 lbs.

1.3.2 Outline Drawings:

E/TFC 115-100	303452
E/TFC 26-100	303346
E/TFC 115-200	303450
E/TFC 26-200	303541

1.3.3 Airflow: All units have internal blowers and depend on forced air cooling in addition to conduction and convection cooling. Air flow paths as indicated in the appropriate Outline Drawing must not be blocked.

1.3.4 Mounting: Unit is designed for bench mounting. Rack adapters are available for 100 VA units as follows:

1.3.4.1 NJE Model RP1A, adapter to mount one unit centered on a standard 19" rack panel 5-1/4" high: order NJE Part No. 08539.

1.3.4.2 NJE Model RP1A, adapter to mount one unit offset to the left on a standard 19" rack panel 5-1/4" high: order NJE Part No. 08[illegible]855.

1.3.4.3 NJE Model RP2, adapter to mount any two units on a standard 19" rack panel 5-1/4" high: order NJE Part No. 080537.

1.3.5 Finish: Exterior finished in dark grey enamel equivalent to FED STD 595 chip #26132. Panel marking is white. All other finishes are appropriate paint, plating or chemical film as required.

1.4 OPTIONAL FEATURES:

The specific optional features which are available on any given unit and the general description of these optional features follows:

1.4.1 Suffix (-P): Addition of three wire power cord and plug.

Suffix (-SF): Non-standard finish exterior of unit.

1.4.2.1 Where specifying (-SF) option customer must provide NJE the following information:

Color to be used (preferably FED STD 595 chip number).

Color to be used for marking.

Process to be used if other than NJE Standard finish process.

Whether paint is to be supplied by customer or NJE.

1.4.3 Prefix (E): Deletion of meters.

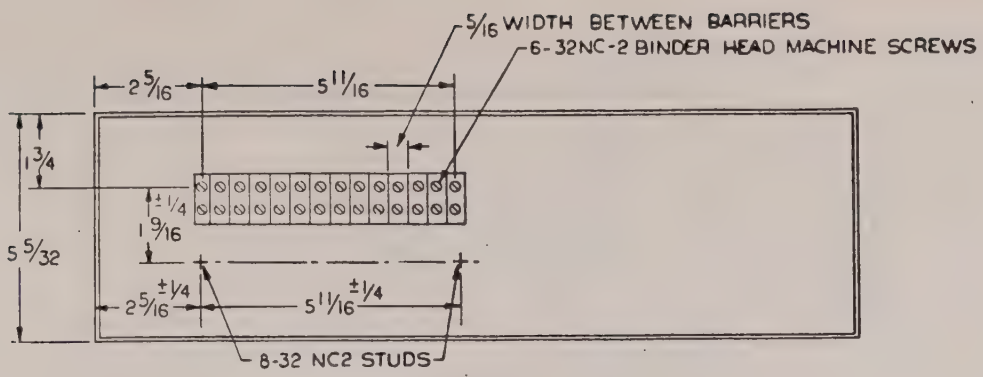
1.4.4 Suffix (230): Conversion of unit to nominal input of 230 Volts.

1.4.5 See Paragraph 1.3.4 for rack adapters.

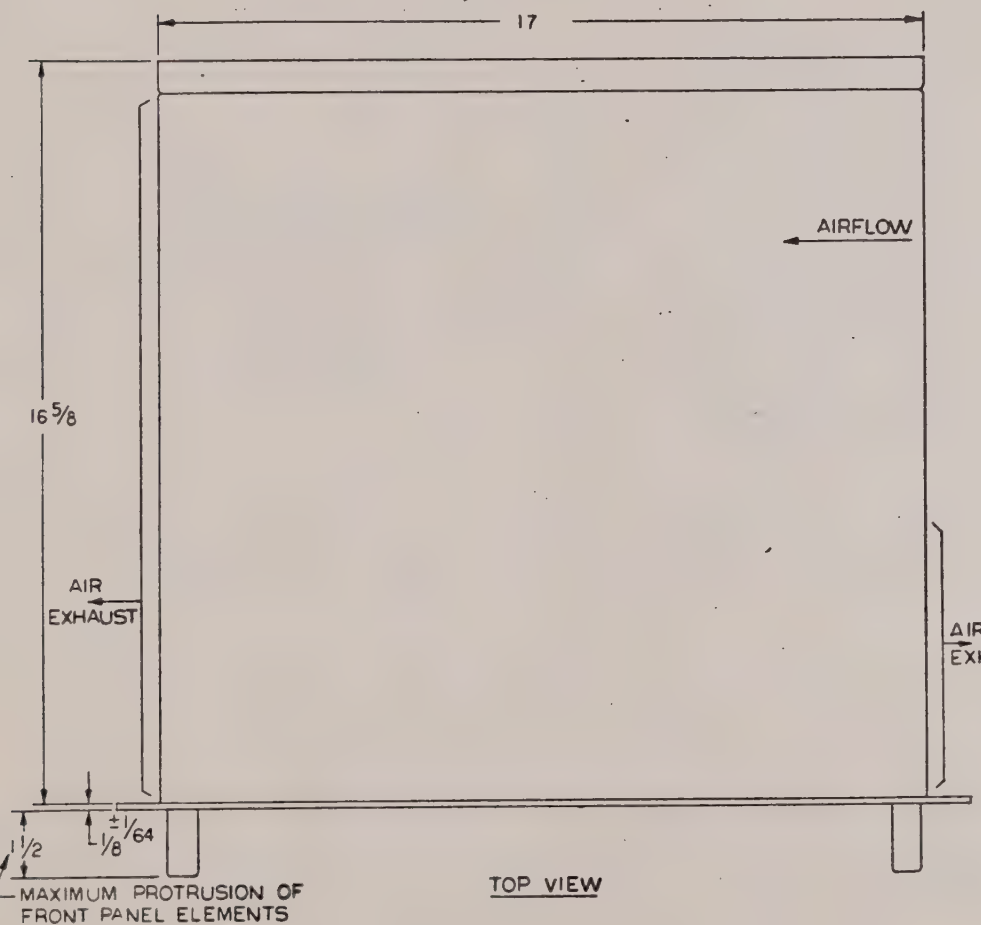
NOTE: Example of buildup of final model for a TFC-115-100 without meters and with line cord is as follows: E/TFC-115-100-P.

NOTE: NJE Corporation invites requests for quotations on special requirements which can be accomplished by deviations of standard catalogue units.

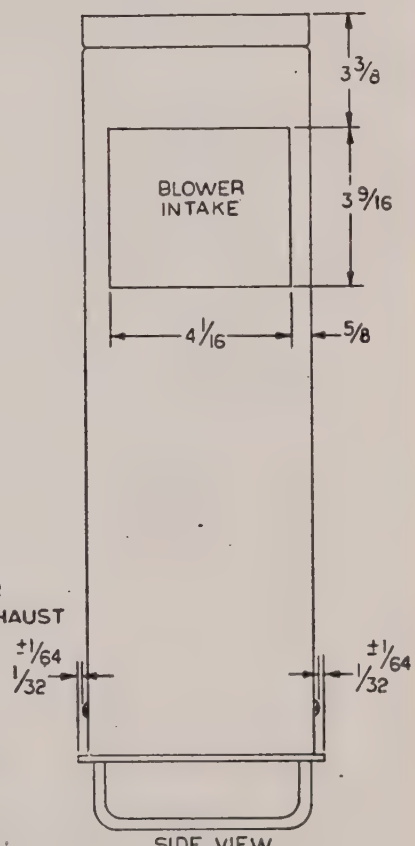
1.4.6 Suffix (TF) Addition of tuning fork for higher frequency stability.



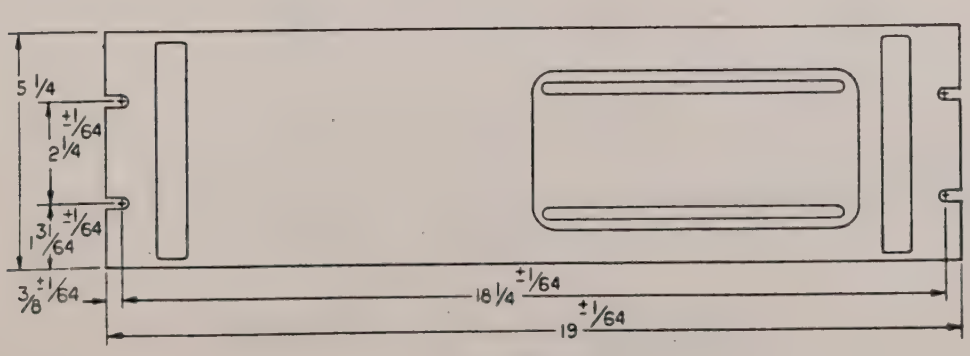
REAR VIEW



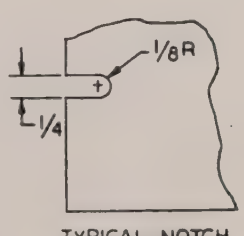
TOP VIEW



SIDE VIEW



FRONT VIEW

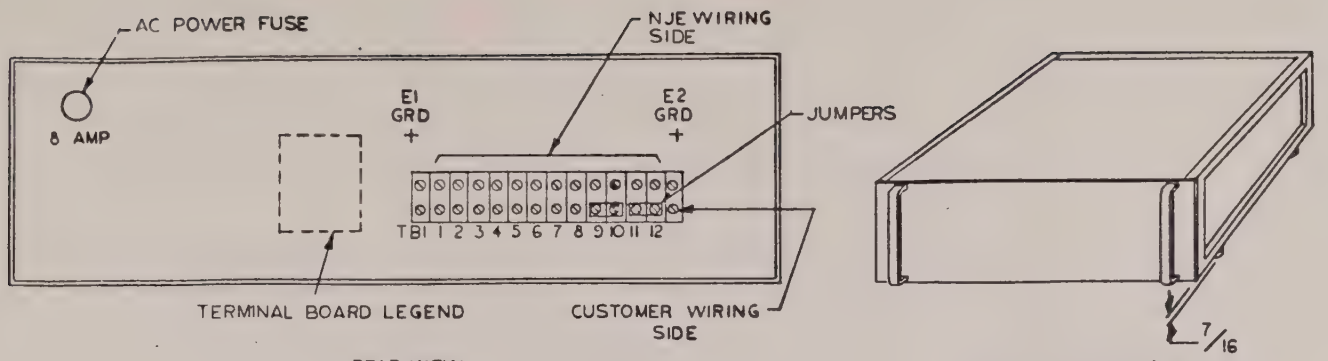


TYPICAL NOTCH

NOTE:
1. ALL TOLERANCES ± 1/32 UNLESS OTHERWISE SPECIFIED.

OUTLINE DRAWING
5 1/4" PANEL SERIES

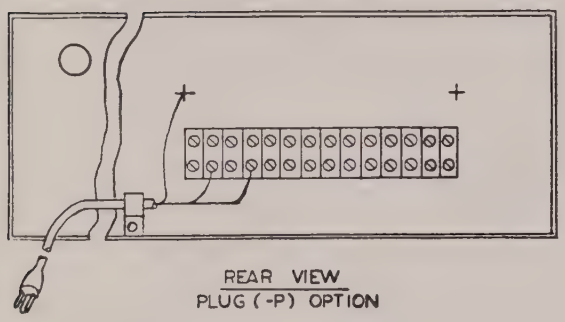
303541



REAR VIEW

REAR PLATE ELEMENTS

BENCH ADAPTER (-B) OPTION



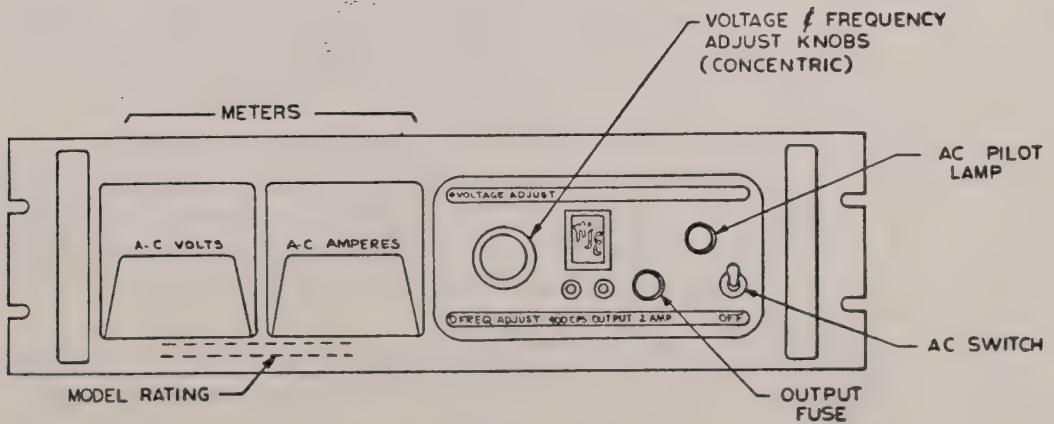
REAR VIEW
PLUG (-P) OPTION

TB1 TERMINAL BOARD LEGEND			
TERM NO	SCREENED FUNCTION	RECOM'D WIRE SIZE	REMARKS
1	50/60 CPS INPUT	NO 16 AWG	HIGH SIDE OF AC INPUT
2	GRD	NO 18 AWG	INPUT AC GROUND
3	50/60 CPS INPUT	NO 16 AWG	RETURN SIDE OF AC INPUT
4	400 CPS OUTPUT ①	NO 18 AWG	HIGH SIDE OF AC OUTPUT
5	GRD	NO 18 AWG	OUTPUT AC GROUND
6	400 CPS OUTPUT ①	NO 18 AWG	RETURN SIDE OF AC OUTPUT
7	EXTERNAL SYNC	NO 20 AWG EACH	SEE MANUAL FOR USE
8			
9	REMOTE FREQ. PROG	NO 20 AWG PAIR	NORMALLY JUMPED TOGETHER
10			
11	REMOTE VOLT. PROG	NO 20 AWG PAIR	NORMALLY JUMPED TOGETHER
12			

① 60 CPS FOR 60 CPS MODELS

NOTES:
1. E-OPTION UNITS DO NOT CONTAIN METERS.

E1	GRD	NO 18 AWG	CHASSIS GROUND
E2	GRD	NO 18 AWG	CHASSIS GROUND



FRONT VIEW

FRONT PANEL ELEMENT
TFC LINE
5 1/4 PANEL SERIES

SECTION II

INSTALLATION AND OPERATION

2.1 UNPACKING: The power supply is shipped in a cardboard carton which is floated on sufficient insulation in a heavy-duty shipping carton. Aside from normal precaution against damage to the unit in opening the cartons and removing the unit, no special procedures are required. The carton should be opened immediately upon receipt and the contents inspected for shppping damage. The Power Supply was checked electrically and mechanically before it left the factory, and is warranted to be in perfect operating condition. This guarantee does not cover possible damage incurred during shipment. Therefore, any evidence of mishandling, such as broken, deformed, or missing parts, should be brought to the attention of the transportation company and a claim should be entered. Remove top cover plate and inspect all components and wiring, both on the chassis and panel, as well as the mechanical condition of the housing, The literature packed with the supply should be removed and held for reference in operating the equipment.

2.2 INSTALLATION: The supply can be mounted in any convenient location for bench use, and requires no adjustment or modification for such application. If the unit is to be installed in a housing, it is recommended that the rack or cabinet used be equipped with angle brackets, shelves, or slides to receive the unit, rather than suspending the assembly by its front panel. Rack adapters for the 100 VA units are available as discussed in Section 1. Installation information is provided in Figure 2-3.

CAUTION !!

In mounting the unit, consideration must be given to provide adequate ventillating space for the forced-air cooling system of the frequency converter.

2.2.1 When the unit has been properly placed in position, or mounted in its rack and secured in place by the panel screws, refer to appropriate outline drawing in Section 1 and make the following connections:

Item 1: Output Ground-The ground terminal (TB1-5)is used to extend a safety ground to the external load. It may also be used to ground one side of the balanced output thereby unbalancing the system to ground. Use a No. 16 AWG wire for this connection as required.

NOTE: The output ground connector can also be effected from the panel block binding posts on 100 VA units.

Item 2: Output Connection-Connect the 400 cps load to the output terminals (TB1-4 and TB1-6) using No. 14 AWG wire. Wire size may vary depending on location of supply and load.

NOTE: The output load connection can also be effected from the front panel red binding posts.

Item 3: Remote Programming-(voltage) Terminsls (TB1-11 and TB1-12) are provided for the insertion in series of a remote control programming resistor. This circuit has a sensitivity of about 3.0 ohms per volt above the minimum output voltage. When the panel voltage adjustment is set to minimum, the output voltage may be accurately controlled from minimum to maximum voltage by varying the remote resistance.

Item 4: Remote Programming (frequency) Terminals (TB1-9 and TB1-10) are provided for the insertion in series of the other remote programming resistor. The circuit has a sensitivity adjustment is set to minimum, the output frequency may be accurately controlled from 380 to 420 cps by varying the remote resistance.

Item 5: External Synchronization-Terminals (TB1-7 and TB1-8) are provided for operating units as a 2 or 3 phase generator in conjunction with the adapter Model TPAR 3-30 or TPAB 3-30. The frequency changer can also be synchronized at this point by a precise laboratory generator. Consult factory for details.

Item 6: Input Connection-Connect a deactivated input line (normal 115/230 volts, 50/60 cycles, single phase) to the AC input terminals. Connect "hot" lead of system to (TB1-1) neutral lead to (TB1-3). In the 230 volt input option only one side of the line is fused. Therefore it is advisable to add an external fuse to the opposite A.C. input line.

NOTE: Unit is factory wired for 115 volt 50 or 60 cps input. Check schematic for 230 VAC input.

2.3 OPERATION: Set the AC control switch in OFF (open) position.. Set the OUTPUT VOLTAGE control (inner knob) to full counterclockwise position, and set the OUTPUT FREQUENCY control (outer knob) to center scale (400 cps). Energize the AC input line, then place the AC control switch in the ON position.

NOTE 1: The indicator on the front panel should light and a 400 cycle tone may be heard emanating from the frequency changer. Observing the panel voltmeter, adjust the load voltage to the desired value, by means of the VOLTAGE adjust. Check the load current meter to avoid overload conditions. Observing the front panel frequency graduations adjust the output frequency to the desired value. By means of the OUTPUT FREQUENCY ADJUST.

NOTE: 2: If the pilot light on the front panel goes off and the 400 cps output voltage drops to zero, but the internal fan continues to run, (on 115V input units only; for 220V units fan will stop), the thermal over-temperature switch located inside the unit has opened up due to overload or too high an ambient temperature. After the thermal switch automatically resets and the output voltage again appears, check for the cause of the excessive temperature and/or 400 cps overload. If the required voltage value cannot be achieved, de-energize the input line and check connections on the rear terminal strip before referring to the troubleshooting section of this manual.

NOTE3: It is normal for the cover of the unit to run hotter at no load than at full load. If the air flow is blocked, the unit will overheat and the internal thermal switch will trip.

Maximum ambient temperature is 35° C for 50cps operation and 40° C for 60 cps operation. The frequency will stabilize after a 30-minute warm-up period. (The warmup drift will be a few cycles).

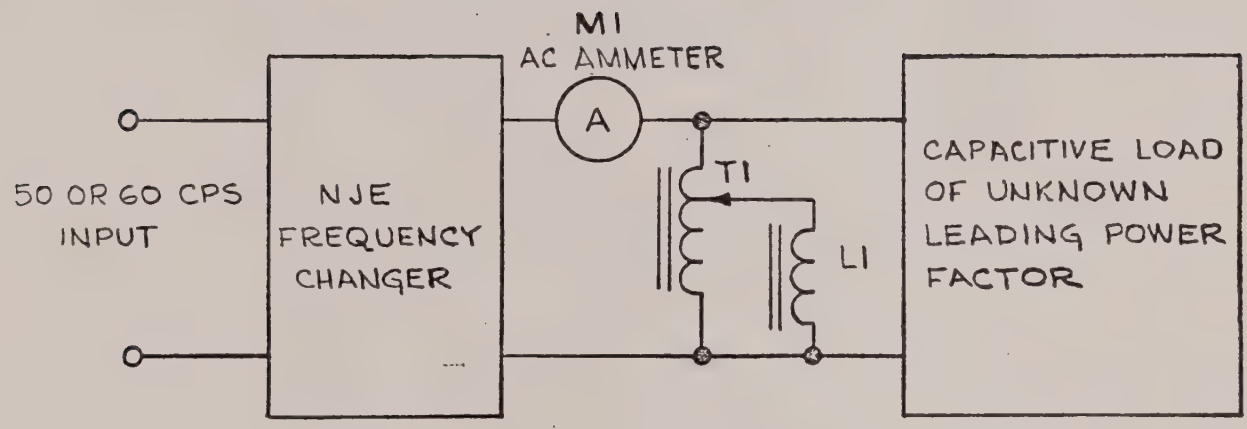
2,3.1 POWER FACTOR CORRECTION: This unit will normally operate into a .8 lagging to unity power factor loads without any additional considerations. However, when the load has a large inductive reactive component, the form factor of the output voltage wave form is altered and the waveform distortion and voltage regulation will change slightly.

This unit is designed for large variations in lagging power factors (from zero lagging to unity). The unit will not supply LEADING power factors safely beyond .8. If LEADING power factors are beyond .8 correct power factors to near unity as shown in Figure 2-2.

When the 400 cps current drawn from the supply is non-sinusoidal (Such as capacitor input filters on D.C. power supplies) the output voltmeter may not reflect the true output voltage during any particular portion of the current waveform. This is due to the output voltage from factor changing.

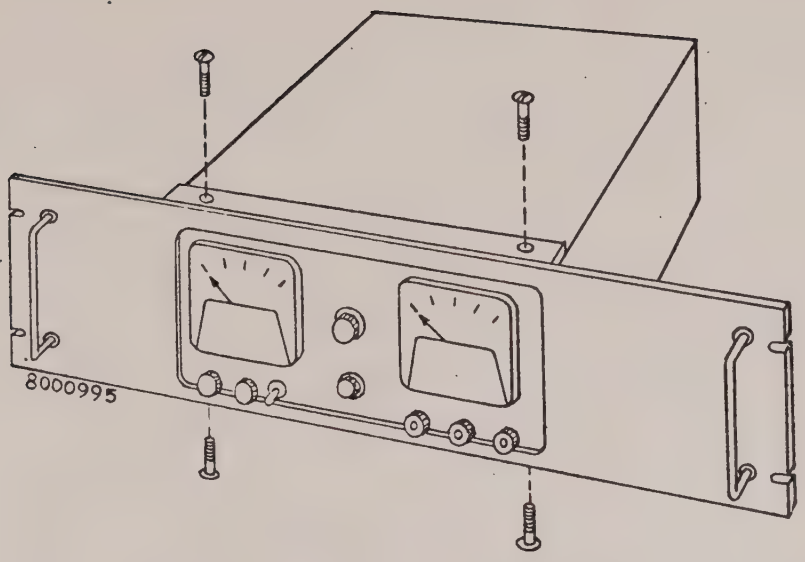
CAUTION ! !

Avoid heavy half wave loads such as a half wave rectifier would produce, A severe half wave load could damage the final amplifier transistors.



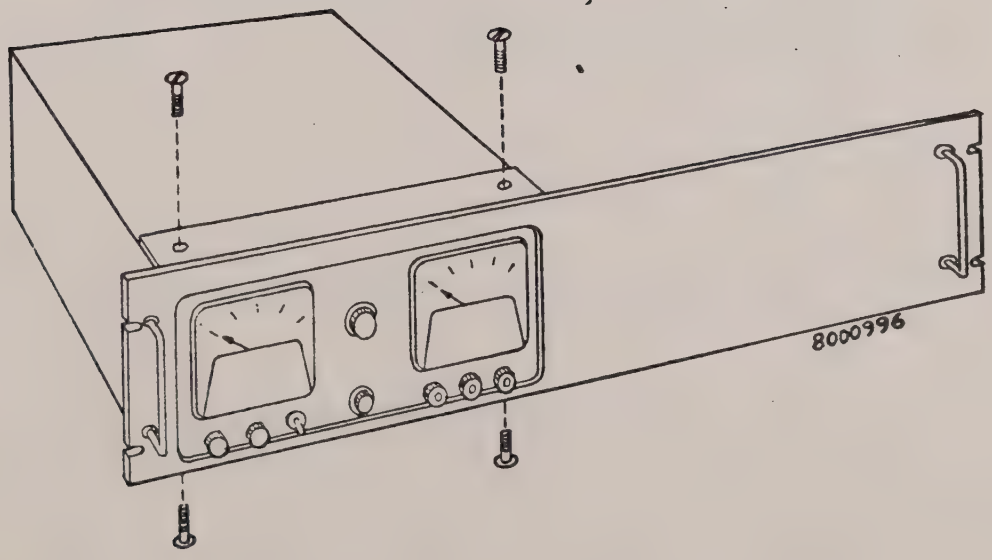
SETUP FOR LEADING POWER FACTOR CORRECTION
FIG. 2-2

T1 IS A VARIABLE TRANSFORMER (VARIAC) 8 AMPS, 120VAC.
L1 IS AN INDUCTOR 1 TO 10 MH @ 5 TO 10 AMPS (CONTACT NJE CORP ENG. DEPT. FOR MORE INFORMATION ON L1)
ADJUST T1 UNTIL M1 CURRENT IS AT MINIMUM. THIS WILL GIVE A TOTAL LOAD POWER FACTOR WHICH IS CLOSEST TO UNITY.



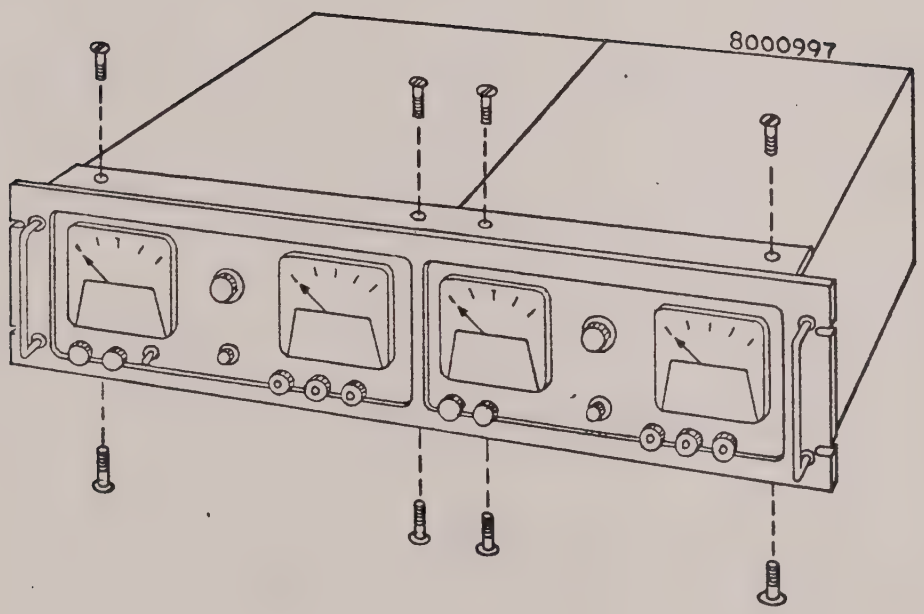
UTILIZING RACK ADAPTER PANEL RP-1

FIG. 2-3A



UTILIZING RACK ADAPTER PANEL RP-1A

FIG. 2-3B



UTILIZING RACK ADAPTER PANEL RP-2

FIG. 2-3C

SECTION III

THEORY OF OPERATION

3.1 GENERAL: Refer to Figure 3-1 the Functional Block Diagram. The power is fed to the input of the transformer and step down rectifier. Part of this rectified DC is used to drive a master oscillator. The DC for the oscillator is further stabilized by a shunt regulator system which samples the output of the oscillator for the error difference. The output of the master oscillator is transformer coupled to the bases of the final amplifier. The output of the final amplifier is sampled for amplitude changes which are monitored by second regulator system. The error difference is fed back to the final amplifier for effecting corrections as required.

3.2 INPUT CONTROL: The power is applied to the frequency converter via the terminal board (TB-1) located in the rear of the unit. The unit is energized by the switch (S1) turn on and lamp (DS1) is lighted. The protective elements in this part of the circuit consist of a fuse (F1) for overload conditions, a fan (B1) for cooling the unit and a thermal cutout switch (S2) for removing over temperature conditions.

The transformer (T1) stepsdown the AC voltage to an appropriate level for application to the bridge rectifier (CR1 through CR4). The pulsating DC from the bridge is smoothed by the RC filter combination (R1 and C1). The DC power is divided between the 400 cps final amplifier and the 400 cps master oscillator. The largest portion of this power is used by the final amplifier which will be discussed later on.

3.3 400 CPS MASTER OSCILLATOR: The principle components of this oscillator circuit are transistors (A1Q1 and A1Q2), resistors (A1R1, A1R3, A1R4 and A1R11), capacitor (A1C7) and a special autotransformer (A1T1). The heart of the oscillator is this transformer (A1T1) which has a core material with an essentially rectangular B versus H (hysteresis) characteristic. Briefly described, the circuit is an overdriven push-pull amplifier with positive feedback derived from the output of an autotransformer.

For the following discussion, refer to Figure 3-2 and 3-3. The prefix designation (A1) has been conveniently omitted. When the 28 volt DC power is applied to the circuit, the two transistors (Q1 and Q2) will immediately start to conduct "slightly". The resistors (R1 and R3) arrange the circuit for a conductive condition and are commonly known as "starting resistors". However, due to some slight component difference, one transistor will immediately start to conduct "heavily". This transistor will be arbitrarily designated (Q1). Almost simultaneously, the transformer action will develop two base voltages in feedback winding of the autotransformer (T1). One of the voltages is polarized in a manner that will turn transistor (Q2) "off" while the other voltage will be of the opposite polarity and will regeneratively turn transistor (Q1) "on" harder.

The transformer core saturates; the transformer action momentarily ceases and a quasi-equilibrium is briefly maintained. Then the status quo collapses, because the "on" transistor is saturated and the power demands of the transformer's exciting current at core saturation results in decline of power into the circuit momentarily. Reversed transformer action sets in and the feedback voltages have reversed in polarity. Transistor (Q2) is now regeneratively turned "on" and Transistor (Q1) is turned "off". This will continue until the core has saturated in opposite polarity region and the above cycle is repeated. The repetition period is determined, by the DC voltage applied across the primary of T1. The frequency of oscillation is directly proportional to the voltage applied across T1 primary. The method used in NJE Frequency Changer Model TFC is to provide a highly stabilized voltage system which can be precisely controlled and the unit is programmable from a remote location by varying a resistor in series with the front panel control (R1A). The AC output power output of the master oscillator is essentially a square wave and is divided three ways. One path is the transformer coupled to the final amplifier and the other two paths are the 18 volt regulator and 18 volt bias.

3.4 VOLT REGULATOR: For the following discussion refer to Figure 3-1. Part of the AC output of the master oscillator is used to provide power for the differential amplifier circuitry. The AC power is rectified by diodes (CR2 and CR4) and the pulsating DC is smoothed by capacitor (A1C2). The differential amplifier, consisting of transistor (A1Q4 and A1Q5), has one arm stabilized by the reference diodes (A1CR5) and other arm (A1Q5) is connected to the sensing divider (R1A, A1R9 and A1R10) for sampling the voltage variations. The shunt regulation (A1Q3) can be considered as a variable resistor under the control of the differential amplifier. The effective shunt resistance at any instant is determined by the error difference as determined by the base condition of the two transistors (A1Q4 and A1Q5). The regulated power is applied to the base of the transistor (A1Q1 and A1Q2) through the clamping diodes (A1CR1 and A1CR3).

3.5 FINAL AMPLIFIER: Transistors located in finned heat sinks are arranged as a parallel push-pull amplifier.

On the TFC-115-100 and TFC 26-100 Frequency Changer units the final amplifier is switched "on" and "off" by the square wave pulse from the master oscillator. On the TFC-115-200 or the TFC 26-200, frequency changers the final amplifier transistors are driven with an additional emitter follower amplifier. This emitter follower is driven by the square wave pulse from the master oscillator.

This AC power is transformer (T2) couple to the sine wave filter which consists of the inductance of the secondary of transformer (T2) and capacitor (C2). This LC combination filter passes the principle 400 cycle component which is appled to the output terminals. At this point, a small portion of the output is continually sampled for voltage variations.

3.6 SECOND REGULATOR: The sampled voltage from the output is applied to transformer (A1T2) and rectified by diodes (A1CR11) through (A1CR14). A portion of the pulsating DC is smoothed by the RC filter (R22 and C6) and applied to the reference diode (A1CR10) and load resistor (A1R2). The other portion of the pulsating DC is applied to the base of transistor (A1Q8).

The differential amplifier combination of transistor (A1Q5 and A1Q9) has the sample voltage on the base of (A1Q9) and the pulsating DC on the other as mentioned above.

3.7 TUNING FORK: On the TFC 115-200 and the TFC 26-200 units a tuning fork option is available for a higher degree of frequency stability. The output of the fork drives a two stage emitter followers which synchronize the master oscillater. The free running frequency of the master oscillator must be 10 cps below the tuning fork frequency for proper synchronization. It will take about 15 seconds after "turn on" for the tuning fork to come up to the required frequency (some frequency jitter can be expected during warmup).

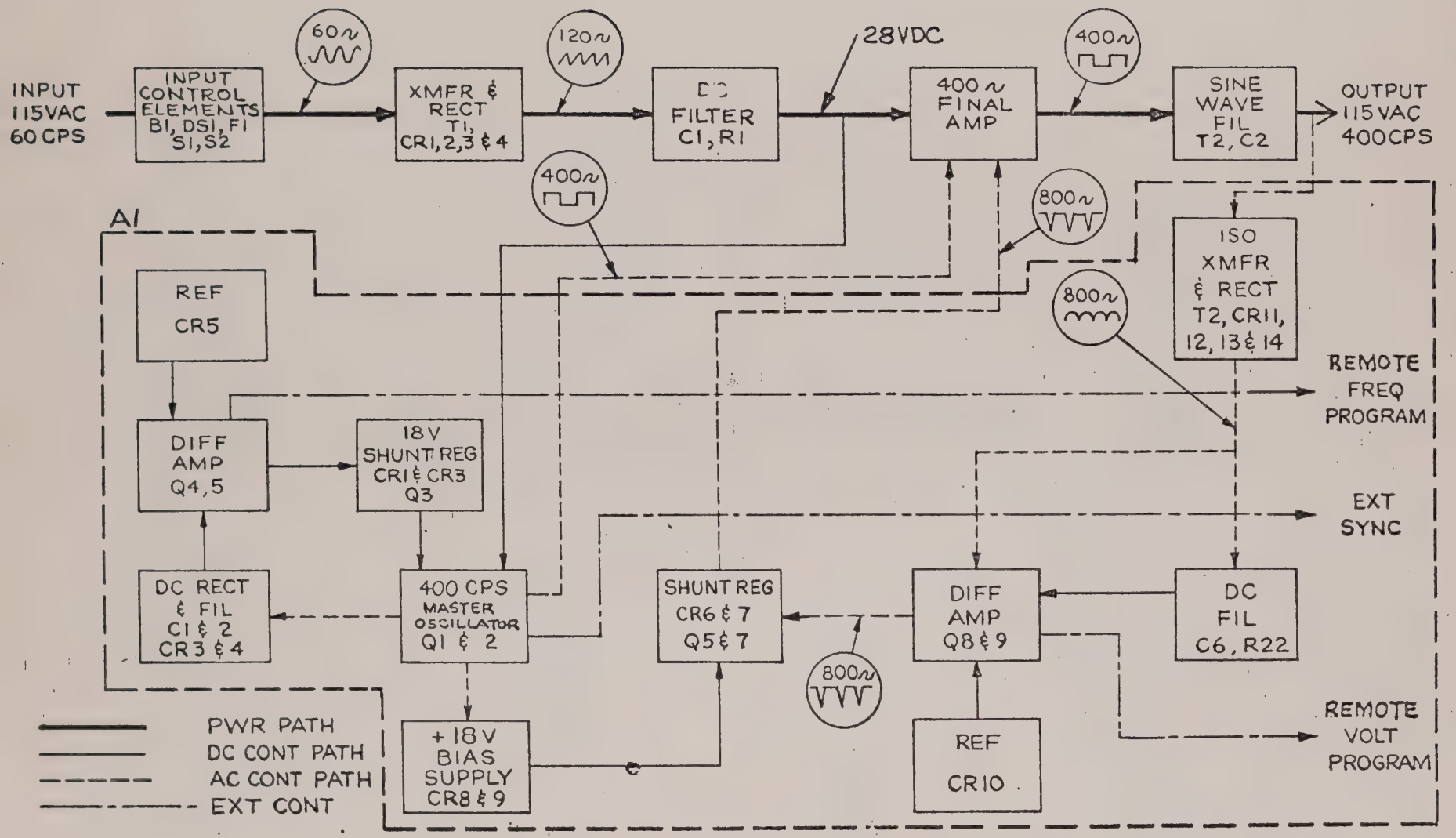


FIG. 3-1

FREQUENCY CONVERTER
FUNCTIONAL BLOCK DIAGRAM

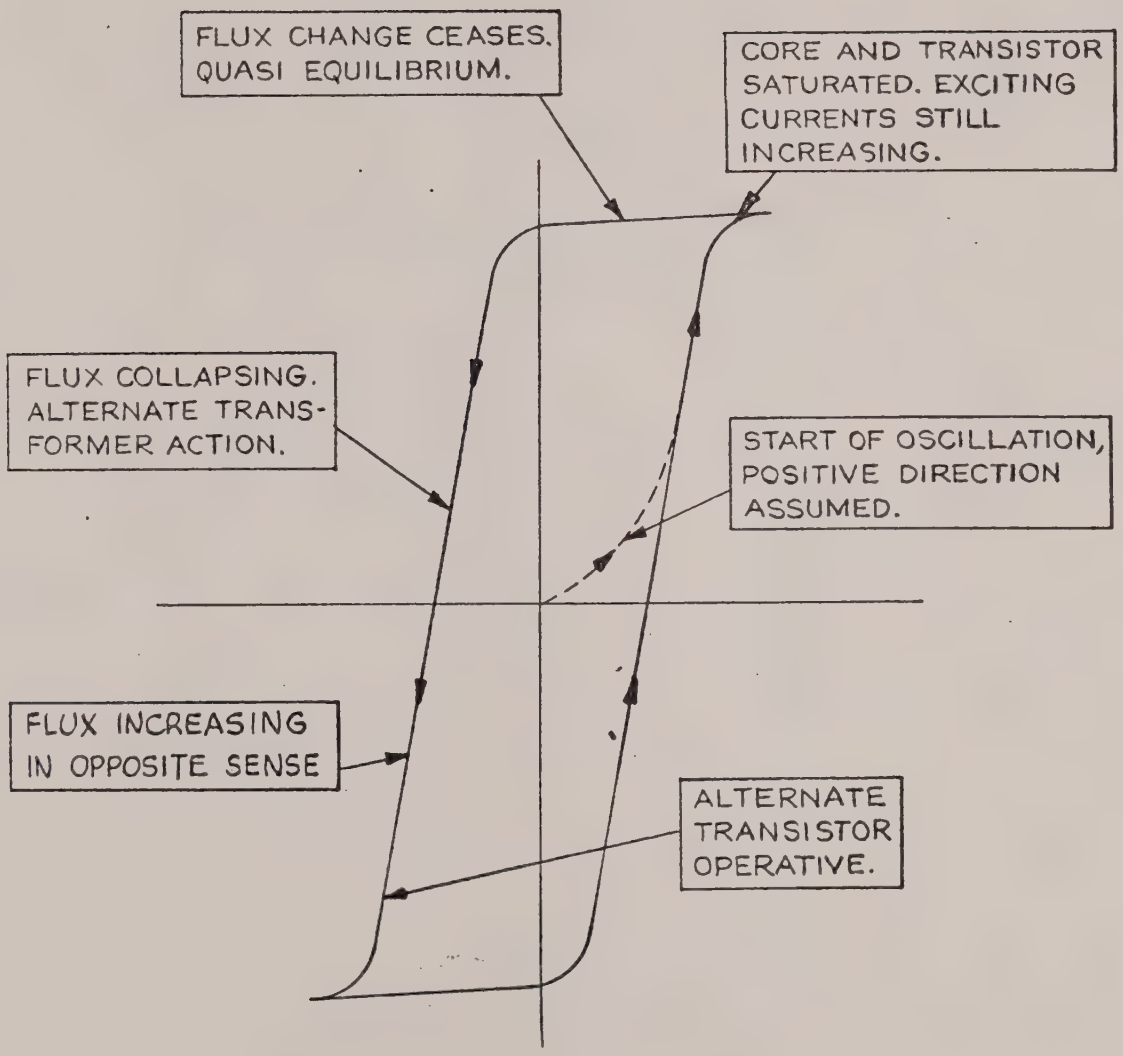

FLUX CHANGE CEASES. QUASI EQUILIBRIUM.
CORE AND TRANSISTOR SATURATED. EXCITING CURRENTS STILL INCREASING.
FLUX COLLAPSING. ALTERNATE TRANS-FORMER ACTION.
START OF OSCILLATION, POSITIVE DIRECTION ASSUMED.
FLUX INCREASING IN OPPOSITE SENSE
ALTERNATE TRANSISTOR OPERATIVE.

FIG. 3-2

CORE CHARACTERISTIC OF OSCILLATOR TRANSFORMER

102046 'CONF

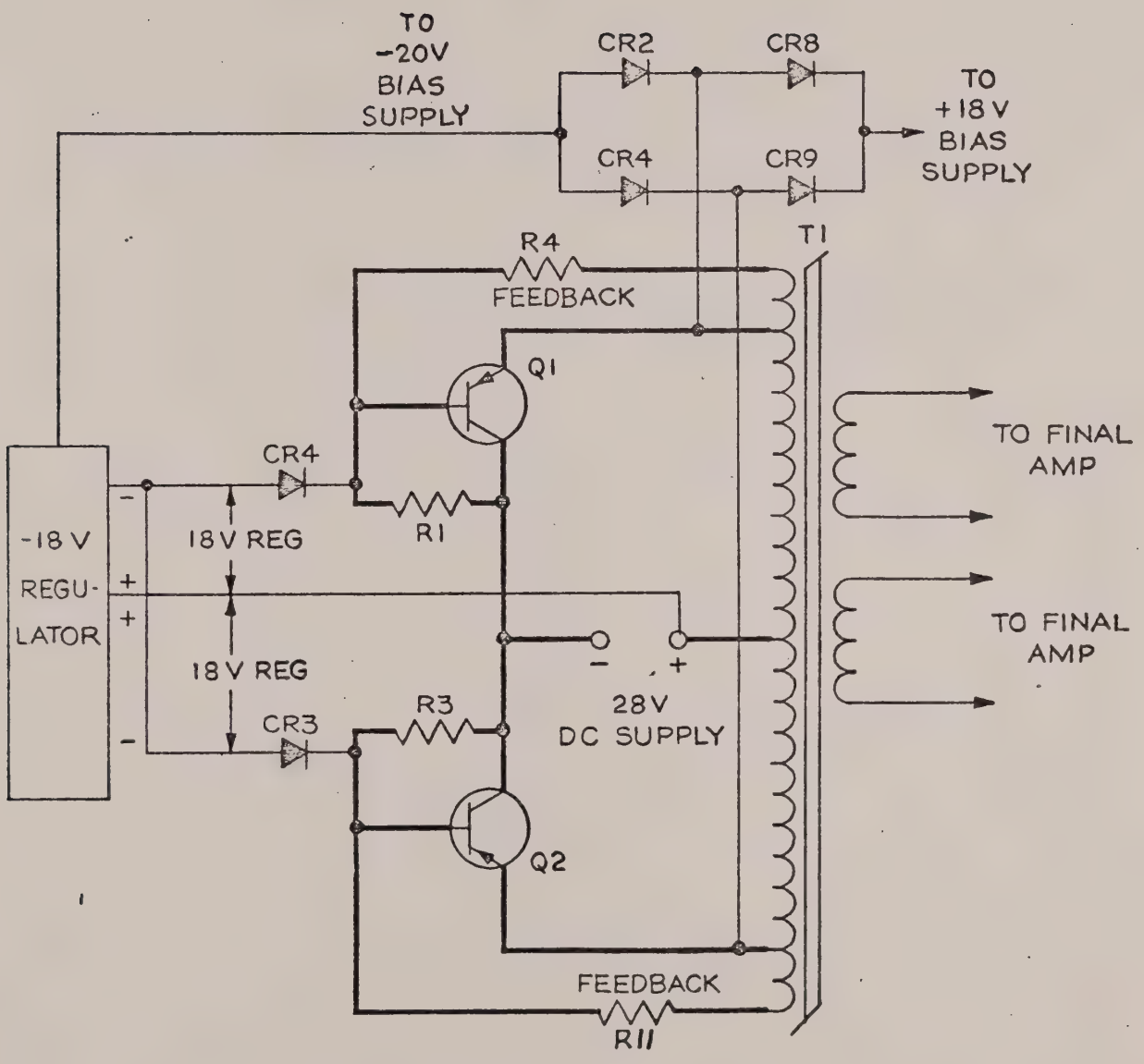


FIG. 3-3

BASIC MASTER OSCILLATOR
AND FEEDBACK SYSTEM

102047 COND

SECTION IV

MAINTENANCE

4.1 GENERAL: Reference drawings for this power supply are provided in rear of the Manual. The exact Schematic Drawing is shown in Figure 4-4. Physical location of components is indicated in the Parts Placement Drawing in Figure 4-3.

This supply is designed for stable operation over long periods of time. However, if trouble develops, standard test equipment normally found in the Electronics Laboratory would be required. If the customer decides to do complete servicing on his premises, one or more of the following pieces of test instruments are required.

Instrument	Range	Remarks
Frequency Counter	300 to 600 cps	Precise Frequency Check
Oscilloscope	General Purpose	General troubleshooting
Multimeter (Ohmmeter)	General Purpose	General troubleshooting
AC Voltmeter (Precision)	0-150V	Precise regulation check
Variable Autotransformer	Capable of suppling the input voltage and current as specified in Para. 1.2.	General troubleshooting
Dummy Load	Range depends on supply rating	

WARNING ! !

THE POWER SUPPLY SHALL
BE DE-ENERGIZED WHENEVER
ANY COMPONENTS ARE REPLACED.

4.2.1 PREVENTATIVE MAINTENANCE: The principal item that will require attention is the cooling arrangement. The power supply generally requires some amount of convection air currents for cooling purposes. Some high power units have forced air cooling. If the air currents are dust laden, a problem may arise that can lead to premature component deterioration.

This condition reduces the cooling efficiency of the supply. We therefore recommend a periodic cleaning if dusty climate prevails.

CAUTION.!!

VACUUM CLEANER MAY LOOSEN THE
SMALL PLUG-IN TRANSISTORS.

4.2.2 Procedure for Oiling the Rotron Muffin fan: The fan (if provided) may require oil if operated under extreme environmental conditions. The fan incorporates the latest electrical and mechanical advances in the motor design and offers reliable performance for 2 to 5 years under favorable conditions of temperature and vibration without the necessity of oiling. Its life is in inverse proportion to these factors. For example, at 110° F the fan may be expected to give reliable performance in excess of three years and at 40° F reliable performance is extended beyond five years.

If the power supply (equipped with fans) should be installed in areas of greater heat, or severe vibration, the life of the fan may be extended by periodic oiling (a small amount once per year) which is absorbed by the bearing. For this oiling procedure, an OIL INJECTOR NJE Part No. 021988 is required and may be ordered from NJE Corporation. This OIL INJECTOR will service from 15 to 20 FANS. For refills order Fan Lubricant NJE Part No. 020923 in 4 oz. can.

Procedure:

Step 1: Remove cap from end of OIL INJECTOR

Step 2: Place needle at the center of circle marked on the Gold Lable.

Step 3: Position the needle at an angle of approximately 45° to the surface of the lable and tangent to the perimeter of the circle.

Step 4: Pierce the label and the concealed self-sealing rubber cap located under the label.

Step 5: Insert the needle approximately 1/4".

Step 6: Depress the plunger of the OIL INJECTOR slowly to the next calibration mark which will allow 1/16" of oil to escape.

NOTE: it is better to give a little more oil than not enough. However, do not overflow the well. If the ambient temperatures are extremely hot, it may be advisable to oil more frequently to insure the optimum performance characteristics of the fan.

4.3 TROUBLESHOOTING: A chart has been provided in the rear of the Manual for case of identifying source of trouble. Use this chart in the following manner.

First: Locate symptom in left hand column,
Second: Read across for numbers indicating order of probable causes shown on top.

4.4 ALIGNMENT AND ADJUSTMENT:

4.4.1 Frequency Calibration or Adjustment: The unit normally does not require adjustment for frequency. If certain components are replaced, a re-alignment for frequency is mandatory.

NOTE: If a frequency "trimming" is required only, Step #1 below may be omitted as required.

Components Associated With Frequency Calibration:

A1CR5 - Breakdown Diode (reference)
R1A - Output Frequency Adjust - Var. Res.
A1R9 - Output Frequency Trim - Var. Res.
A1R10 - Output Frequency Range - Var. Res.
A1R12 - Frequency Regulator -Var. Res.
A1T1 - Oscillator Transformer

STEPS: (Frequency Calibration)

1. Set OUTPUT FREQUENCY TRIM AND OUTPUT FREQUENCY RANGE variable resistors (A1R9) and (A1R10) to the middle of their range and set FREQUENCY REGULATOR variable resistor (A1R12) fully clockwise.

   NOTE: All items of this step located on 83 PC or 110 PC printed circuit board.

2. Set OUTPUT FREQUENCY ADJUST variable resistor (R1A), located on front panel, to the 400 cps marking.

3. Connect a frequency counter across the cathodes of diodes (A1CR2 and A1CR4) located on printed circuit board.

4. Energize the TFC frequency converter unit.

5. Readjust OUTPUT FREQUENCY TRIM variable resistor (A1R9) for 400 cps as indicated on frequency counter.

   NOTE: clockwise direction decreases frequency.

6. Rotate OUTPUT FREQUENCY ADJUST variable resistor (R1A) fully clockwishe and then completely counter-clockwise.

NOTE: The two settings represent the low and upper limits of the frequency range of the unit and should be 380 to 420 cps. If this range requirement is not met, then readjustments of step 7 are required.

7. Readjust OUTPUT FREQUENCY RANGE variable resistor (A1R10) for proper range.

NOTE1: The counter clockwise direction decreases the range.

NOTE 2: Variable resistive controls (A1R9) and (A1R10) have some interaction. Back and forward adjustments will be required until the specified voltage range and 400 cps calibration requirements are met.

8. Arrange output of unit for making a full load to no load change. Monitor output with frequency counter during load change.

NOTE: If change in frequency is more than 1 cps, readjust FREQUENCY REGULATOR variable resistor (A1R12) as required to improved frequency regulation.

9. Repeat above steps 3 through 7 as A1R9, A1R10 and A1R12 have same interaction.

10. Place cover on the unit and allow 15 minutes of stabilization. Give the unit a final frequency check at output terminals (J1 and J2) and trim variable resistor (A1R9) as required.

4.4.2 VOLTAGE CALIBRATION: The unit normally does not require adjustments for voltage. If certain components are replaced, a realignment for voltage is mandatory.

COMPONENTS ASSOCIATED WITH VOLTAGE CALIBRATION

A1CR10 - Breakdown Diode (reference)
A1R16 - Output Voltage Trim - Var. Res.
A1R17 - Frequency Resistor
R1B - Output Voltage Adjust Var. Res.
A1T2 - Isolation Transformer

STEPS: (VOLTAGE CALIBRATION:)

1. Set OUTPUT VOLTAGE ADJUST variable resistor (R1B), located on front panel, fully counter clockwise.

2. Energize TFC Frequency converter unit.

3. Connect precise 150VAC voltmeter across the output (J1 and J2) terminals.

4. Readjust OUTPUT VOLTAGE TRIM variable resistor (A1R16) until output voltage reads 105V.

   NOTE: The clockwise direction decreases the output voltage.

5. Check upper range of OUTPUT VOLTAGE ADJUST variable resistor (R1B). Output voltage should be above 130 VAC when R1B is fully clockwise.

CAUTION ! !

If the output voltage reaches 150V, (50V on E/TFC-26 models) turn off unit immediately. Troubleshooting is indicated.

4.4.3 *TUNING FORK ADJUSTMENT:

1. Remove plug-in tuning fork (Z1) from its socket.

2. Set frequency trim (A1R9) or front panel frequency control (R1B) to about 10 cps below the tuning fork frequency.

3. Replace tuning fork subassembly (Z1) in its socket and turn unit on. During warmup the frequency of the unit will be at about 385 cps and in about 15 second synchronize at 400 cps (providing 400 cps fork is used.) Some frequency jitter can be expected during the 15 second period.

4.4.4 THERMOSTAT ADJUSTMENT: The Thermostatic switch located on final amplifier heat sink unit is set at the factory for proper operation. If the Thermostat switches pre-maturely, a clockwise adjustment will increases the temperature cut out point.

* On TFC-115-100 and TFC 26-100 tuning fork is located externally.

CAUTION !!

Extreme care should be exercised when adjusting the thermstat switch clockwise. The temperature rating of the final amplifier transistor will be exceeded if the thermostat is turned to far clockwise. For better temperature protection turn the thermostatic switch counter clockwise as much as possible and still have the unit operational

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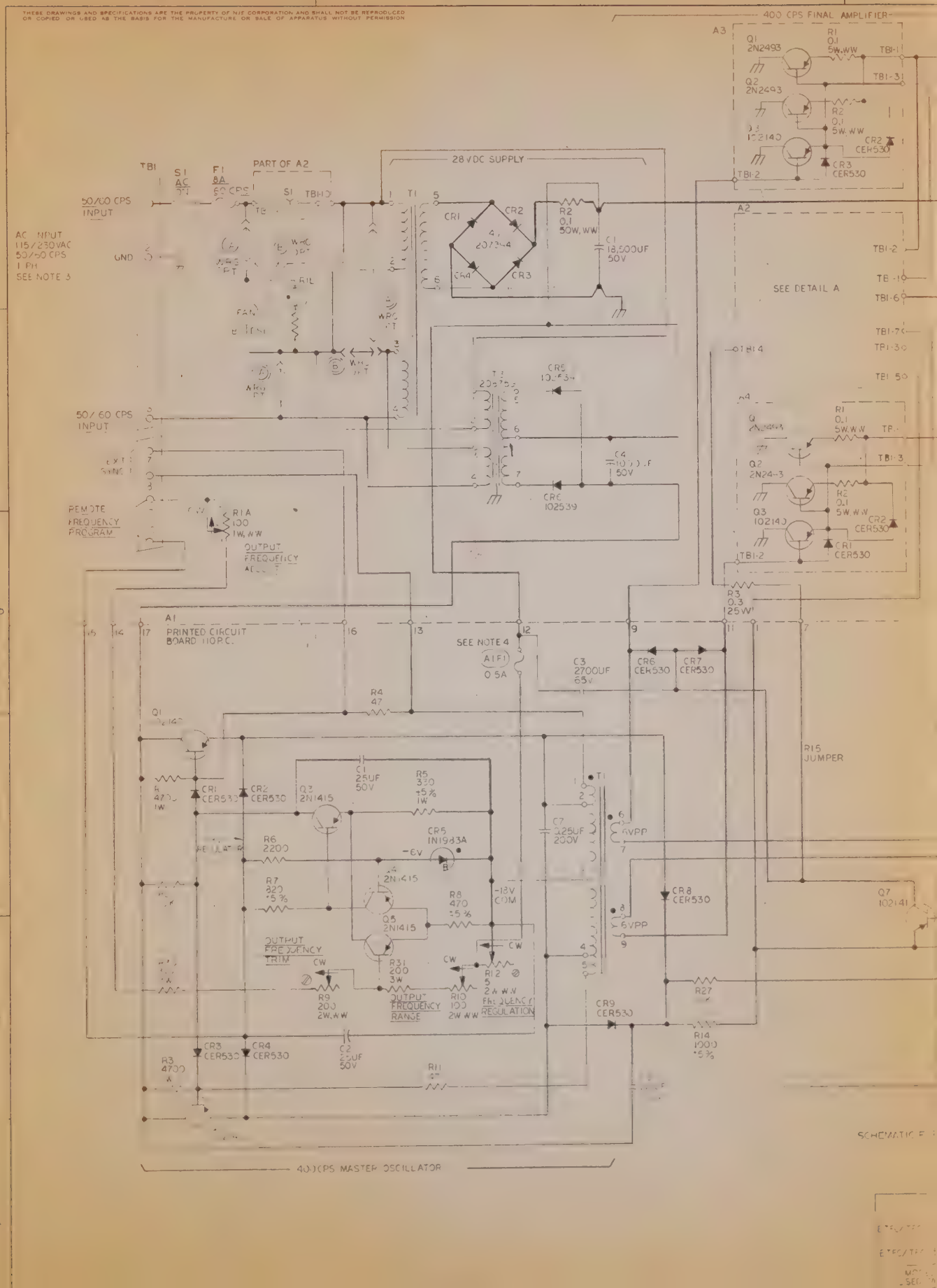

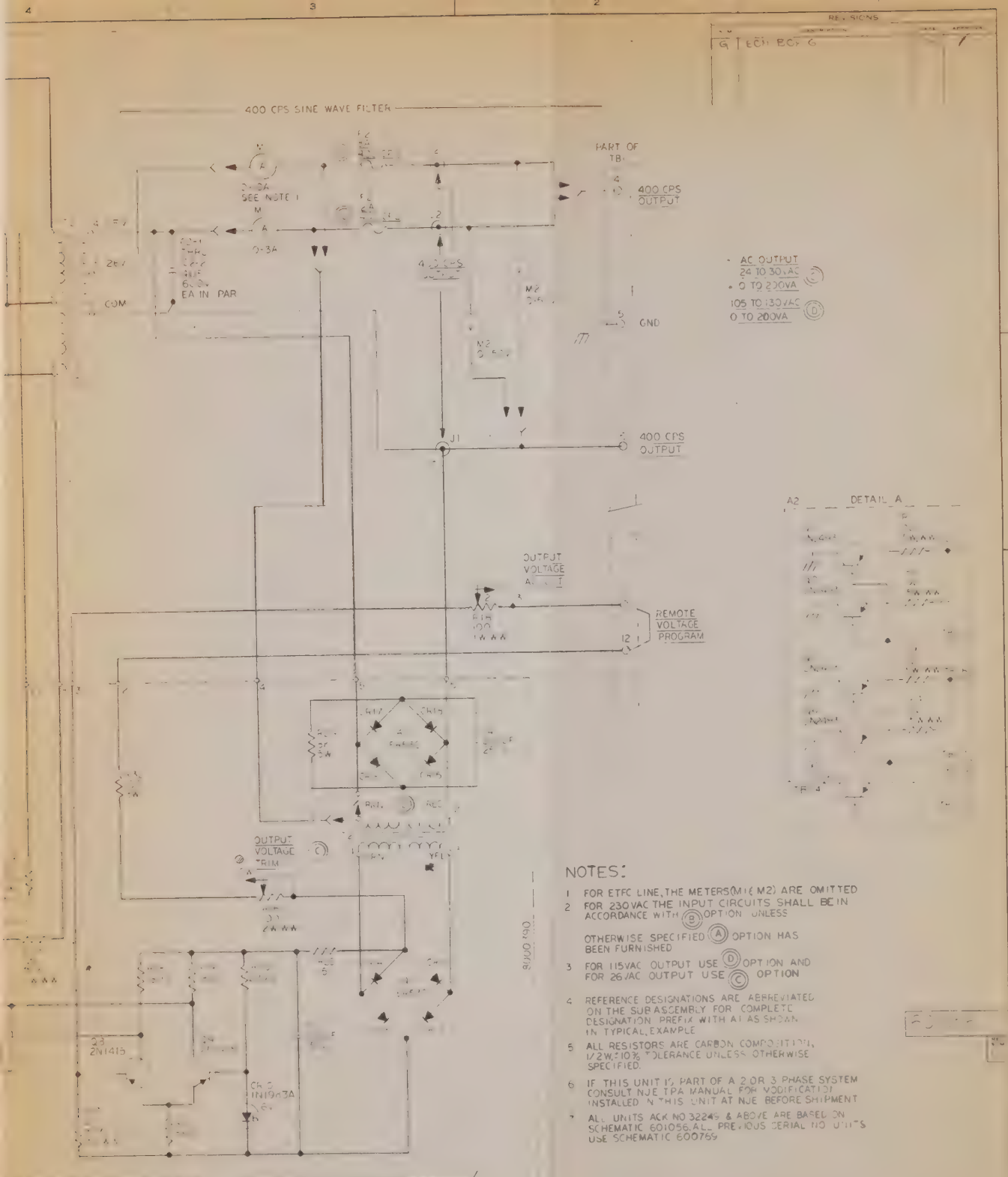

NOTES:

1. FOR ETFC LINE, THE METERS (M1 & M2) ARE OMITTED
2. FOR 230 VAC THE INPUT CIRCUITS SHALL BE IN ACCORDANCE WITH (B) OPTION UNLESS OTHERWISE SPECIFIED (A) OPTION HAS BEEN FURNISHED
3. FOR 115VAC OUTPUT USE (D) OPTION AND FOR 26 VAC OUTPUT USE (C) OPTION
4. REFERENCE DESIGNATIONS ARE ABBREVIATED ON THE SUBASSEMBLY FOR COMPLETE DESIGNATION PREFIX WITH A1 AS SHOWN IN TYPICAL EXAMPLE
5. ALL RESISTORS ARE CARBON COMPOSITION, 1/2W, ±10% TOLERANCE UNLESS OTHERWISE SPECIFIED.
6. IF THIS UNIT IS PART OF A 2 OR 3 PHASE SYSTEM CONSULT NJE TPA MANUAL FOR MODIFICATIONS INSTALLED IN THIS UNIT AT NJE BEFORE SHIPMENT
7. ALL UNITS ACK NO 32249 & ABOVE ARE BASED ON SCHEMATIC 601056. ALL PREVIOUS SERIAL NO UNITS USE SCHEMATIC 600769

FREQUENCY CONVERTER FIG 5

ARC

ITEM CLASS 103

200A	NJE P/N D 2055	110PC-4 P/N 1 2237	002		SCHEMATIC DIAGRAM MODEL ETFC/TFC 26 200A ETF/TFC115 200A	NJE CORPORATION KENILWORTH N J
200A	NJE P/N 101803	110PC 4	001			SIZE F

2009182

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REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL

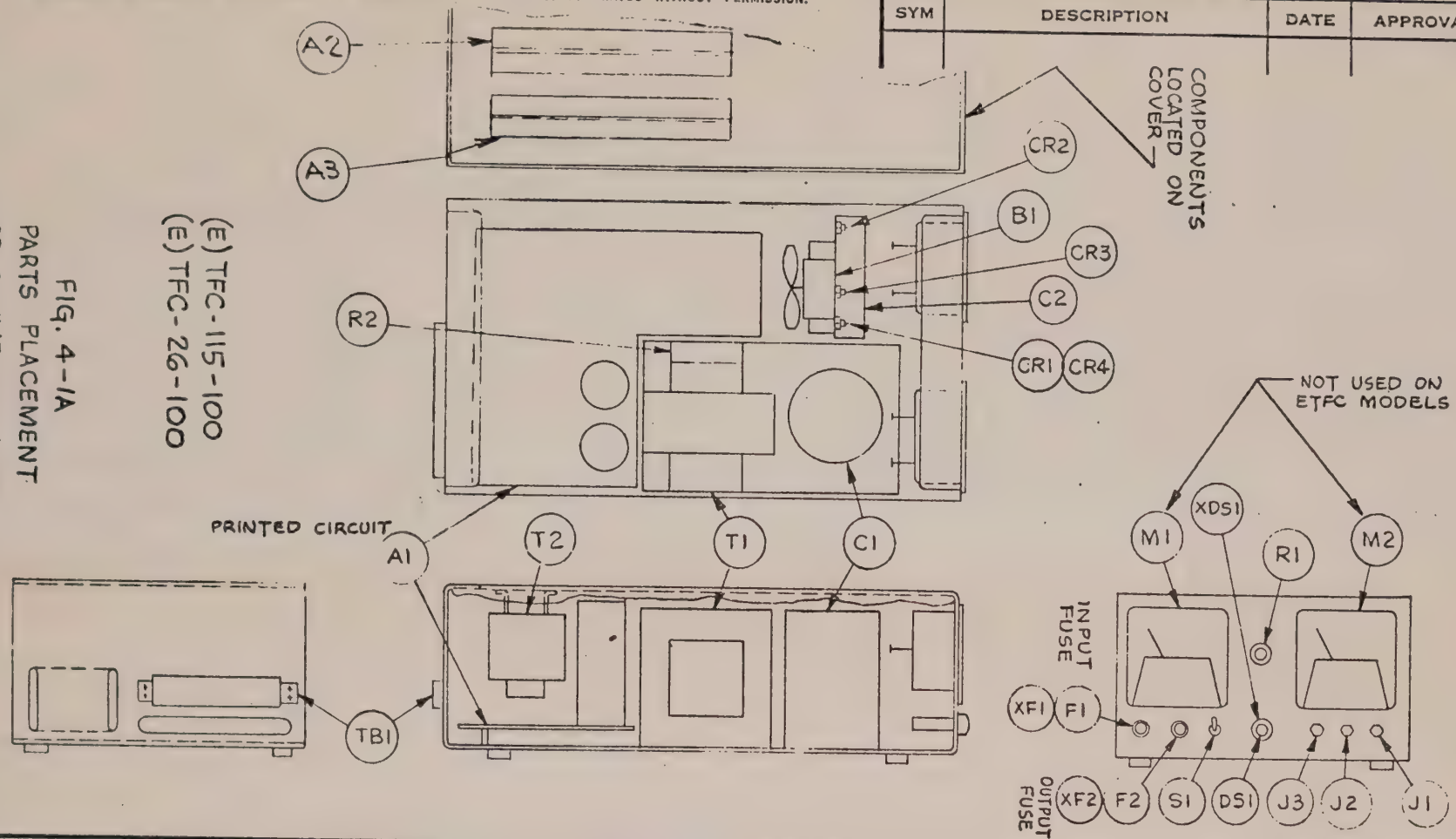


FIG. 4-1A
PARTS PLACEMENT
OF CONVERTER UNIT

(E) TFC-115-100
(E) TFC-26-100

UNLESS OTHERWISE SPECIFIED	DRAFTSMAN J. Salem	DATE 6-28-62	TITLE PARTS PLACEMENT (E) TFC-115-100B AND (E) TFC-26-100B
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± DECIMALS ± ANGLES ±	DESIGNER		
MATERIAL	CHECKER		
	ENGINEER		
PROTECTIVE FINISH	APPROVED		
	DO NOT SCALE DWG		SCALE — WT —

NJE CORPORATION
KENILWORTH, N.J.
CODE IDENT. NO. 98380

DWG SIZE A — 104585

SH 1 OF

FIRST STEP: LOCATE TROUBLE SYMPTOM / SECOND STEP: MAKE CHECK IN SEQUENCE INDICATED	VA LOAD ON INPUT TOO HIGH OR TOO HIGH AMBIENT TEMP.	LOW INPUT LINE VOLTAGE	A1CR8 OPEN OR SHORTED	A1R3 OPEN	A1Q5 SHORTED OR OPEN	A1Q7 SHORTED OR OPEN	A1R12 MISADJUSTED (IF USED)	A1Q3 SHORTED OR OPEN	A1Q4,A1Q5 OPEN OR SHORTED	B1 FAN BLADE NOT TURNING	A1Q1 OR A1Q2 SHORTED	A1CR6 OR A1CR7 OPEN OR SHORTED	IMPROPER DRIVE FROM MASTER OSCILLATOR	A1R23A1R24,A1R25,A1R26 OPEN	C2 SHORTED	S2 OPEN OR MISADJUSTED	CR1,CR2,CR3 OR C24 SHORTED OR OPEN	C1 SHORTED OR OPEN	FINAL AMPLIFIER TRANSISTORS SHORTED	A1CR5 OPEN OR SHORTED	DS1 LAMP BLOWN	IMPROPER SYNCRONIZING HOOKUP IF USED (EXTERNAL)	A1CR1,A1CR2,A1CR3 OR A1CR4 SHORTED OR OPEN	EXTERNAL SYNC. TERMINALS SHORTED	A1C1,A1C2 OPEN OR SHORTED	A1CR8,A1CR9 OPEN OR SHORTED	A1R10 MISADJUSTED	A1R9 MISADJUSTED	A1R10 OPEN	R13 OR R15 OPEN	A1R9 OPEN	REMOTE FREQUENCY PROGRAMMING CIRCUIT OPEN	M2 DEFECTIVE	A1F1 FUSE BLOWN	A1C3,A1C4 OPEN OR SHORTED	A1R16 MISADJUSTED	A1T2 SHORTED OR OPEN	A1CG OPEN OR SHORTED	A1CR11,A1CR12,A1CR13,A1CR14 OPEN OR SHORTED	REMOTE VOLTAGE PROGRAMMING CIRCUIT OPEN	T1 PRIMARY IMPROPERLY CONNECTED	F2 BLOWN	OUTPUT SHORTED AT TB1	R2 OPEN			
NO OUTPUT VOLTAGE BUT FAN RUNS & PILOT LAMP IS LIGHTED (115 VAC INPUT ONLY)	7		9			5										2					10 11																										
F1 BLOWS WITHIN 1 SECOND AFTER UNIT IS TURNED ON	5					6				4				8 7			3 2 1																														
OUTPUT VOLTAGE 150 VAC OR MORE WITH NO LOAD ON OUTPUT			1 3 9 8									11								2																										
OUTPUT VOLTAGE TO LOW OR NEAR ZERO WITH NO LOAD OUTPUT		1 12 4		2 3								7								5								8 9							6 10 11										
OUTPUT FREQUENCY TOO HIGH (450 CPS OR HIGHER)							11	1	2										3								4 5 6 7	10																	
OUTPUT FREQUENCY TOO LOW (350 CPS OR LOWER)		10					11	1	2									3								8 9	6	7 4 5																	
A1F1 REPEATEDLY BLOWS											1															2 3 6 5 4																				
S1 REPEATEDLY OPENS	1		2				4		7						6				5 3																										
NO OUTPUT VOLTAGE FAN DOES NOT RUN (230 VAC INPUT ONLY)	2													3 4	6			5 1																										
FINAL AMPLIFIER TRANSISTORS REPORTEDLY BLOWS	5								7	4	3	1	2	6																														
POOR FREQUENCY REGULATION	3						4	1	2																																			
POOR VOLTAGE REGULATION	6	5	3	4	2	1																																				

8000311

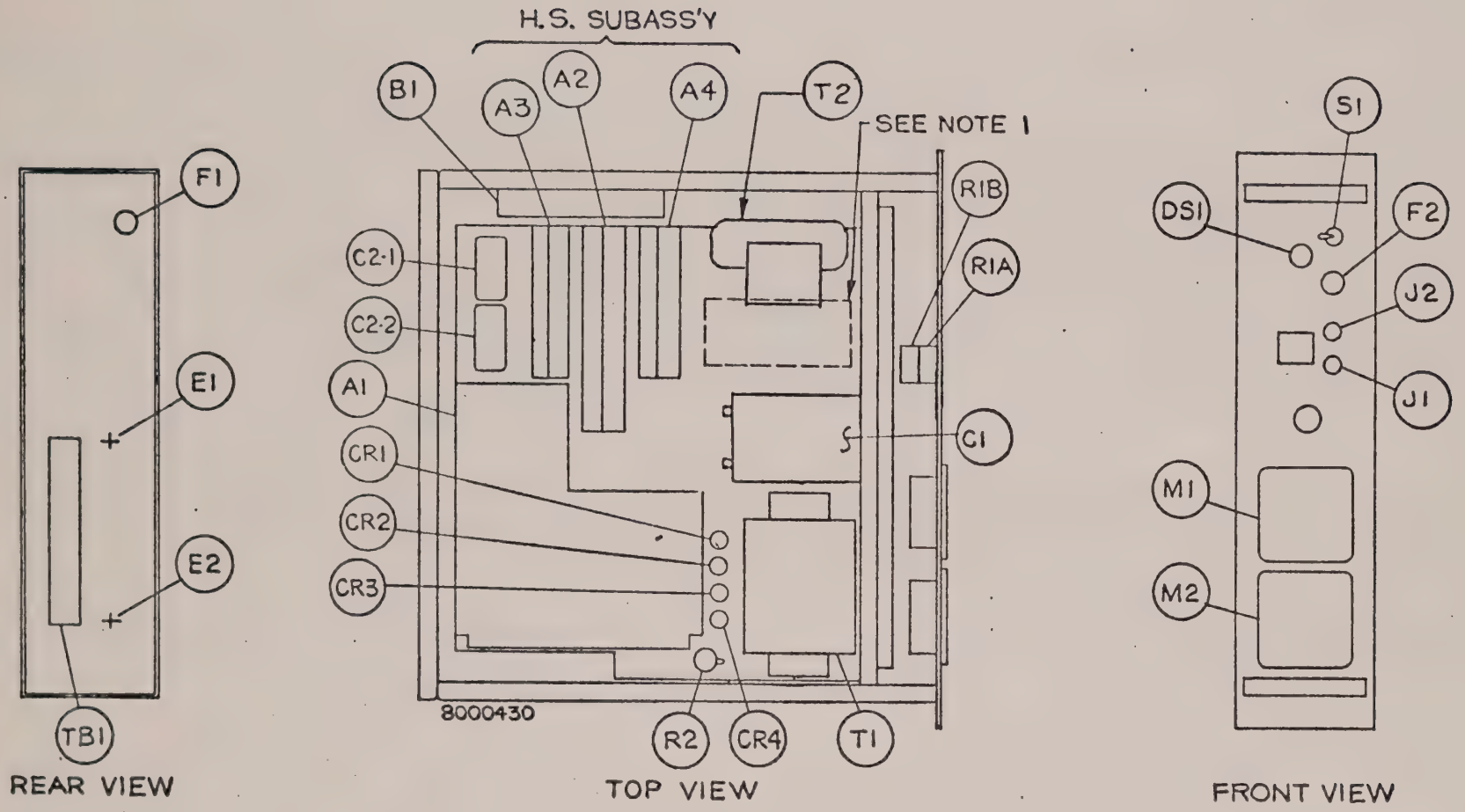
FIG. 4-3

302726

102076

REV. 1- 9-63

REV B ADDED C3 9/25/67 cm
REV C DELETED C3 10/5/67 cm

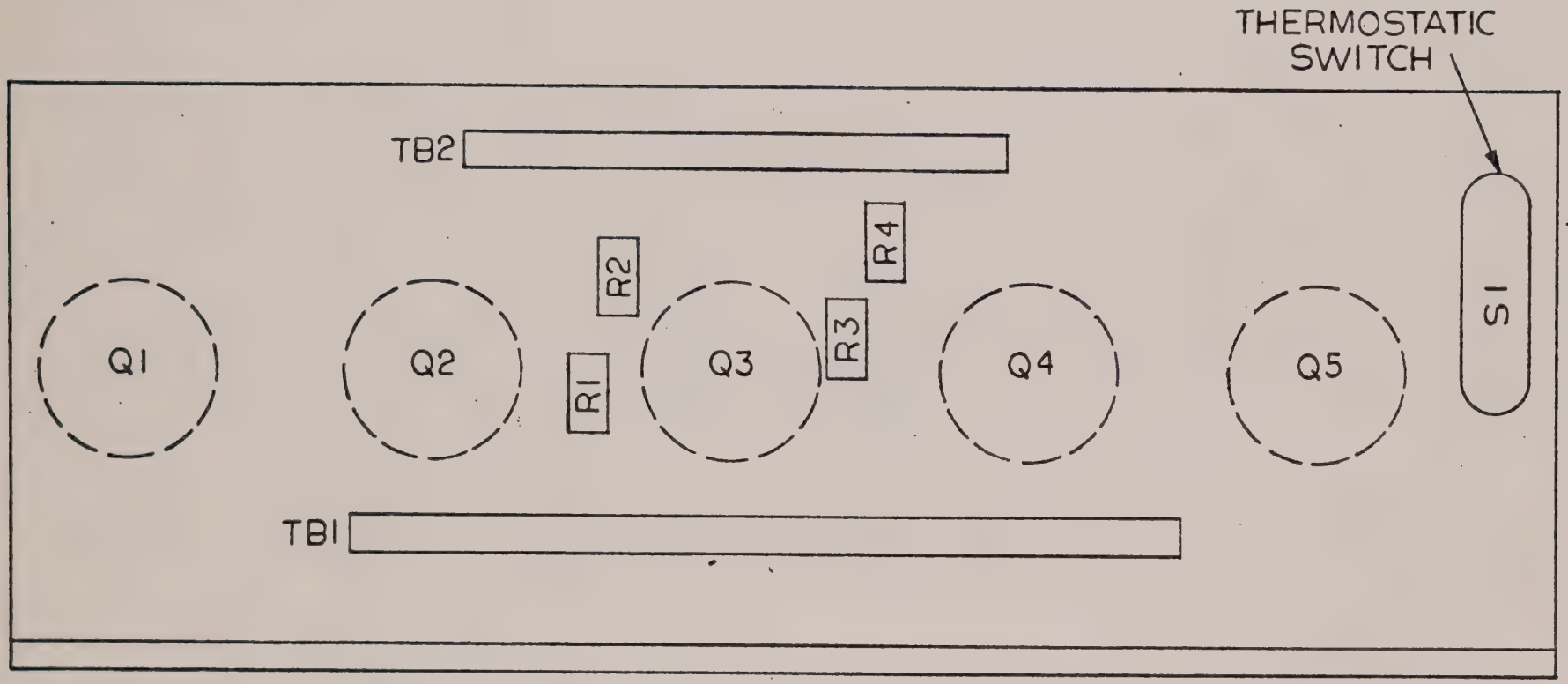


NOTES:

1. THIS AREA RESERVED FOR TUNING FORK SUB-ASS'Y (A5) WHICH IS USED ON SOME UNITS WHEN HIGH DEGREE OF FREQUENCY STABILITY IS REQ'D.

FIGURE 4-1A

PARTS PLACEMENT FOR MAJOR COMPONENTS



PARTS PLACEMENT FOR SUBASSEMBLY
(A2)

FIG 4-1B

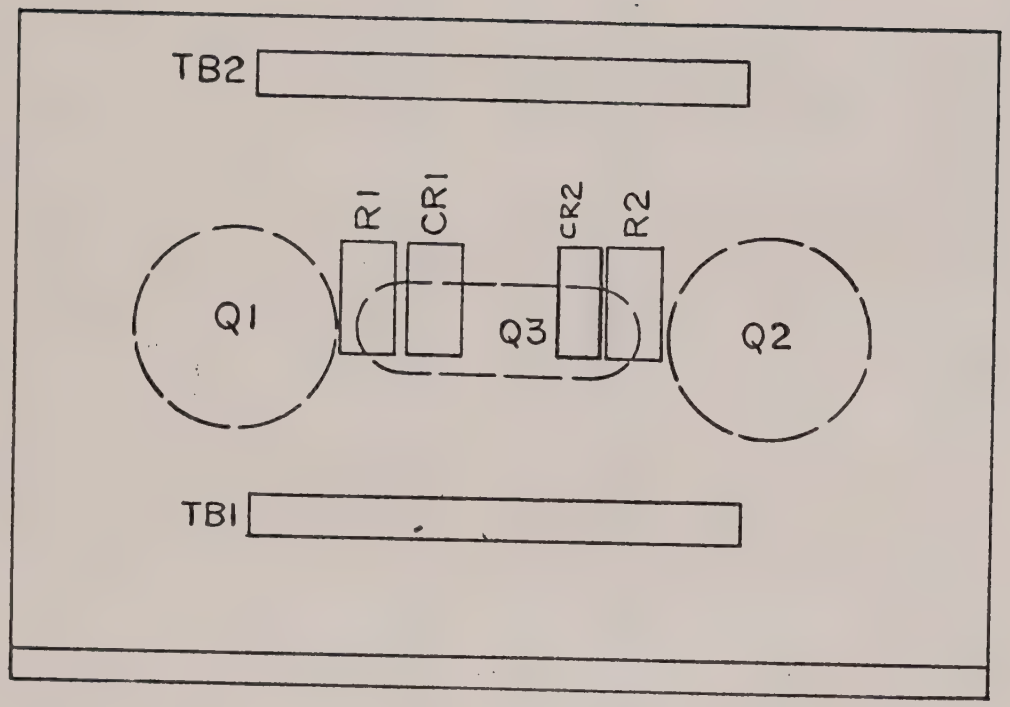


FIGURE 4-1C

PARTS PLACEMENT FOR SUBASSEMBLY
(A3 & A4)

ABBREVIATIONS USED IN SPARE PARTS LIST

In DESCRIPTION Column: "SA" is used to mean "Same As" and "PO" is used to mean "Part Of". Where these symbols are used, the UNIT QTY., SPARE QTY., UNIT PRICE and NJE PART NO., columns are all blank.

In VALUE Column: The use of the letter "R" to indicate a decimal point is illustrated by the following examples: 5.6Ω is written as 5R60K. 1/2 watts is written as R500 W. The use of zeroes does not imply a precision to the indicated number of decimal places but is a requirement of the proper handling of the Data Processing Cards from which these spare parts lists are written.

The standard symbols for electrical units are used and usually appear in the columns immediately to the left of the dashed and solid lines in the Value field. In all cases, the symbol "Ω" is not printed for resistors and is understood. For example: 200Ω is written 200 and 2.7MΩ is written 2R70M.

In REFERENCE DESIGNATION Column: The reference designations are those which interrelate the Spare Parts List, the Schematic Diagrams and the Parts Placement drawings. The symbols are those of MIL-STD-16. Where the reference designation is an "A" (meaning a sub-assembly), a Spare Parts List bearing the NJE Part Number of that assembly is included in the Spare Parts List section.

Deviations: Where minor deviations are accomplished by modifying a standard unit, a Spare Parts List which only shows the deletions and additions from the enclosed standard Spare Parts List is used.

N J E Corp. KENILWORTH, N.J. — Spare Parts List

MODEL TFC 115-200 # 111638 PAGE NO. 1

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*		NJE PART NO.	QTY. USED	SPARE QTY.	UNIT PRICE
A1	110PC-4			111469	1	1	
A2	HS ASSY			81063	1	1	
A3	HS ASSY			81064	2	1	
A4	SAME AS A3						
A5	NOT USED						
B1	BLOWER 60 Hz	115V 1PH 5IN		2	1	1	18.00
C1	CAP, FXD ELECT	18,500μF	50 V	107365	1	1	20.00
C2-1	CAP, FXD PAPER	4μF	600V	846	2	1	5.00
C2-2	SAME AS C2-1						
C3	NOT USED						
C4	CAP, FXD ELECT	1000μF	50V	111629	1	1	
CR1	DIODE, RECT	12A	200V	207394	4	2	4.00
CR2	SAME AS CR1						
CR3	SAME AS CR1						
CR4	SAME AS CR1						
CR5	DIODE, RECT	500MA	300V	102539	2	2	1.20
CR6	SAME AS CR5						
DS1	PILOT LAMP	T3	.250V	24	1	1	.50
F1	FUSE, CARTRIDGE	8.00A	250V	231	1	5	.20
F2	FUSE, CARTRIDGE	2.00A	250V	25	1	5	.25
J1	CONNECTOR RECEPT 1 PIN		30A	33	2	1	.80
J2	SAME AS J1						
M1	METER, AMP AC	3.0A		3796	1	1	26.00
M2	METER, VOLT AC	150.0V		3802	1	1	26.00
R1	RES, VAR WW DUAL	100&100	2W	106046	1	1	3.00
R2	RES, FXD WW	.10	50W	501478	1	1	2.20
R3	RES, FXD WW	0.3	25W	500256	1	1	1.75
S1	SWITCH, TOGGLE	SPST	15A	121	1	1	1.50
T1	TRANSFORMER			204826			
T2	TRANSFORMER			81070			
T3	TRANSFORMER			208759			
TB1	TERMINAL BOARD	12 TERM 20A		123	1	1	2.16
XDS1	LAMPHOLDER	RD CLEAR 125V		105063	1	1	2.00
XF1	FUSEHOLDER	30A	250V	127	2	1	.70
XF2	SAME AS XF1						

*SPARE PARTS LIST SPECIFYING TYPICAL VENDOR'S NAME AND PART NUMBER IS AVAILABLE ON SPECIAL ORDER ONLY.

1 - When ordering spare parts it is necessary to specify the serial number and model number (available on the warranty label on the rear of the unit) and the NJE Part No. from this spare parts list.
2 - Unit Price shown above is subject to change without prior notice.
3 - NJE Corp. reserves the right to make design improvements on this unit without prior notice.
4 - Spare Quantity shown above is recommended quantity for one year isolated service.

MODEL TFC 115-200 # 111638 PAGE NO. 2

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*		NJE PART NO.	QTY. USED	SPARE QTY.	UNIT PRICE
	110PC-4			111469			
C1	CAP, FXD TANT	25μF	50V	21	3	1	7.50
C2	SAME AS C1						
C3	CAP, FXD ELECT	2700μF	65V	111345	1	1	3.95
C4	CAP, FXD ELECT	200μF	250V	699	1	1	8.00
C5	CAP, FXD TANT	2.5μF	100V	21991	1	1	5.80
C6	CAP, FXD TANT	100μF	30V	226	1	1	6.00
C7	CAP, FXD PAPER	.25μF	200V	20815	1	1	3.95
CR1	DIODE, RECT	500MA	300V	138	16	5	1.20
CR2	SAME AS CR1						
CR3	SAME AS CR1						
CR4	SAME AS CR1						
CR5	DIODE, RECT 10%	150MW	5.6V	135	2	2	5.00
CR6	SAME AS CR1						
CR7	SAME AS CR1						
CR8	SAME AS CR1						
CR9	SAME AS CR1						
CR10	SAME AS CR1						
CR11	SAME AS CR1						
CR12	SAME AS CR1						
CR13	SAME AS CR1						
CR14	SAME AS CR1						
CR15	SAME AS CR1						
CR16	SAME AS CR1						
CR17	SAME AS CR1						
CR18	SAME AS CR1						
F1	FUSE, CARTRIDGE	.50A	250V	3692	1	5	.25
Q1	XSTR, PNP G	10W	80V	102140	2	2	4.00
Q2	SAME AS Q1						
Q3	XSTR, PNP G	200 MW	25V	393	5	2	1.75
Q4	SAME AS Q3						
Q5	SAME AS Q3						
Q6	NOT USED						
Q7	XSTR, PNP G	10W	60V	102141	1	1	6.00
Q8	SAME AS Q3						
Q9	SAME AS Q3						
R1	RES, FXD COMP	4.70K	1W	1047	2	1	.14
R2	RES, FXD COMP	10.00K	.500W	66	2	1	.05
R3	SAME AS R1						
R4	RES, FXD COMP	47.00	.500W	178	2	1	.05
R5	RES, FXD COMP 5%	330.00	1W	21937	1	1	.14
R6	RES, FXD COMP	2.20K	.500W	346	2	1	.05
R7	RES, FXD COMP 5%	820.00	.500W	4623	1	1	.20
R8	RES, FXD COMP 5%	470.00	.500W	184	1	1	.20
R9	RES, VAR WW	200.00	2W	107440	1	1	2.50

*SPARE PARTS LIST SPECIFYING TYPICAL VENDOR'S NAME AND PART NUMBER IS AVAILABLE ON SPECIAL ORDER ONLY.

1 - When ordering spare parts it is necessary to specify the serial number and model number (available on the warranty label on the rear of the unit) and the NJE Part No. from this spare parts list.
2 - Unit Price shown above is subject to change without prior notice.
3 - NJE Corp. reserves the right to make design improvements on this unit without prior notice.
4 - Spare Quantity shown above is recommended quantity for one year isolated service.

N J E Corp. KENILWORTH, N.J. — SPARE PARTS LIST

MODEL TEC 115-200 # 111638 PAGE NO. 3

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*		NJE PART NO.	QTY. USED	SPARE QTY.	UNIT PRICE
R10	RES, FXD WW	100.00	2W	107444	2	1	1.00
R11	SAME AS R4						
R12	RES, VAR WW	5.00	2W	107438	1	1	1.75
R13	RES, FXD WW	1.50	5W	505307	2	1	1.00
R14	RES, FXD COMP 5%	1.00K	.500W	451	1	1	.20
R15	JUMPER, WIRE			107986	1	1	
R16	SAME AS R10						
R17	RES, FXD WW	82.00	3W	501626	1	1	.86
R18	RES, FXD COMP	1.80K	.500W	989	2	1	.10
R19	SAME AS R18						
R20	SAME AS R6						
R21	RES, FXD COMP	560.00	.500W	58	1	1	.10
R22	RES, FXD COMP	15.00	.500W	177	1	1	.10
R27	SAME AS R2						
R28	SAME AS R13						
R29	RES, FXD WW	8.00	5W	505308	1	1	1.25
R30	RES, FXD WW	470.00	3W	110627	1	1	.80
R31	RES, FXD WW	250.00	3W	110623	1	1	.98
R32	RES, FXD WW	100.00	3W	110620	1	1	.98
T1	TRANSFORMER	[illegible]		204686	1	1	16.00
T2	TRANSFORMER			101803	1	1	16.00
XQ1	SOCKET, XSTR	2 PIN		2543	3	1	.30
XQ2	SAME AS XQ1						
XQ3	SOCKET, XSTR	4 PIN		128	5	1	.75
XQ4	SAME AS XQ3						
XQ5	SAME AS XQ3						
XQ6	NOT USED						
XQ7	SAME AS XQ1						
XQ8	SAME AS XQ3						
XQ9	SAME AS XQ3						
	HS ASSY			81063			
Q1	XSTR, PNP G	170W	70V	109163	4	2	12.00
Q2	SAME AS Q1						
Q3	XSTR, PNP S	125W	30V	102325	1	2	5.50
Q4	SAME AS XQ1						
Q5	SAME AS XQ1						
R1	RES, FXD WW	.10	5W	448	4	1	1.20
R2	SAME AS R1						
R3	SAME AS R1						
R4	SAME AS R1						
S1	SWITCH, THERMAL			207084	1	1	3.50
TB1	TERMINAL BOARD	10 TERM	5A	294	1	1	1.00
TB2	TERMINAL BOARD	7 TERM	5A	293	1	1	1.00

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N J E Corp. KENILWORTH, N.J. — Spare Parts List

MODEL TFC 115-200 # 111638 PAGE NO. 4

REFERENCE DESIGNATION	DESCRIPTION VENDOR NAME*	RATINGS VENDOR PART NO.*		NJE PART NO.	QTY. USED	SPARE QTY.	UNIT PRICE
	HS ASSY			81064			
CR1	DIODE RECT	750MA	300V	138	2	2	1.20
CR2	SAME AS CR1						
Q1	XSTR, PNP G	170W	70V	109163	2	2	12.00
Q2	SAME AS Q1						
Q3	XSTR, PNP G	10W	80V	102140	1	2	4.00
R1	RES, FXD WW	.10	5W	448	2	1	1.20
R2	SAME AS R1						
TB1	TERMINAL BOARD	5 TERM	5A	211	2	1	1.00
TB2	SAME AS TB1						

*SPARE PARTS LIST SPECIFYING TYPICAL VENDOR'S NAME AND PART NUMBER IS AVAILABLE ON SPECIAL ORDER ONLY.

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2 - Unit Price shown above is subject to change without prior notice.
3 - NJE Corp. reserves the right to make design improvements on this unit without prior notice.
4 - Spare Quantity shown above is recommended quantity for one year isolated service.

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Our Warranty:

NJE Corporation warrants all power supplies manufactured by it, to be free from defects in material or workmanship. Our liability, under this warranty, is limited to servicing, or adjusting any instrument returned to the factory or to an NJE field service center for that purpose, and to replacing any defective parts thereof. This warranty is made to the original purchaser and applies to all standard catalogue listed equipment for two years after delivery to the original purchaser. The provisions of this warranty shall not apply to any power supply which has been subject to misuse or which has been repaired or altered by the purchaser in any way so as, in the judgment of NJE Corporation, to adversely affect its performance or reliability, nor to normal deterioration of appearance due to wear or exposure.

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